PROCEEDINGS

OF

THE ROYAL SOCIETY.

1834–1835. No. 20.

April 2, 1835.

JOHN WILLIAM LUBBOCK, Esq., M.A., V.P. and Treasurer, in the Chair.

James Burnes, M.D.; Joseph Delafield, Esq.; G. W. Featherstonhaugh, Esq.; James Alexander Gordon, M.D.; Colonel Sir Robert John Harvey; Thomas Leybourn, Esq.; George Moore, Esq.; Arthur Morgan, Esq.; Charles Henry Oakes, Esq., B.A.; John Henry Pelly, Esq.; Richard Taunton, M.D.; William Tite, Esq.; Samuel Warren, Esq.; James Wigram, Esq., M.A.; and Charles J. B. Williams, M.D.; were elected Fellows of the Society.

A paper was read, entitled, "On the Results of Tide Observations, made in June 1834, at the Coast-Guard Stations in Great Britain and Ireland." By the Rev. W. Whewell, F.R.S., Fellow of Trinity College, Cambridge.

On a representation made by the author of the advantages which would result from a series of simultaneous observations of the tides, continued for a fortnight, along a great extent of coast, orders were given for carrying this measure into effect at all the stations of the Preventive service on the coasts of England, Scotland, and Ireland, from the 7th to the 22nd of June inclusive. From an examination of the registers of these observations, which were transmitted to the Admiralty, but part of which only have as yet been reduced, the author has been enabled to deduce many important inferences. He finds, in the first place, that the tides in question are not affected by any general irregularity, having its origin in a distant source, but only by such causes as are merely local, and that therefore the tides admit of exact determination, with the aid of local meteorological corrections. The curves expressing the times of high water, with relation to those of the moon's transit, present a very satisfactory agreement with theory; the ordinates having, for a space corresponding to a fortnight, a minimum and maximum magnitude, though not symmetrical in their curvatures on the two sides of these extreme magnitudes. The amount of flexure is not the same at different places; thus confirming the result already obtained by the comparison of previous observations, and especially those made at Brest; and demonstrating the futility of all attempts to deduce the mass of the moon from the phenomena of the tides, or to correct the tables of the tides by means of the mass of the moon. By the introduction of a local, in addition to the general, semimenstrual inequality, we may succeed in reconciling the discrepancies of the curve which represents this inequality for different places; discrepancies which have hitherto been a source of much perplexity. These differences in the semimenstrual inequality are shown by the author to be consequences of peculiar local circumstances, such as the particular form of the coast, the distance which the tide wave has travelled over, and the meeting of tides proceeding in different directions; and he traces the influence of each of these several causes in producing these differences. A diurnal difference in the height of the tides manifests itself with remarkable constancy along a large portion of the coast under consideration. The tide hour appears to vary rapidly in rounding the main promontories of the coast, and very slowly in passing along the shores of the intervening bays; so that the cotidal lines are brought close together in the former cases, and, in the latter, run along nearly parallel to the shore; circumstances which will also account for comparative differences of level, and of corresponding velocities in the tide stream. The author intends to prosecute the subject when the whole of the returns of these observations shall have undergone reduction.

A paper was also read, entitled, "Copies of Registers of the Thermometer kept at Alford, Aberdeenshire." By the Rev. James Farquharson, F.R.S.

The observations recorded in these tables were made at $9^h\ 15^m$ A.M., and at $8^h\ 30^m$ P.M., each day of the year 1833; and the highest and lowest temperatures in each month observed from the indications of Six's thermometer. The author remarks that the differences between the temperature of the morning and evening hours of observation were greatest, on an average, during clear weather; that is, when the radiation of heat from the ground is greatest.

The reading of another paper, by the same author, entitled "On the Ice, formed under peculiar circumstances, at the bottom of running Water," was commenced, but not concluded.

SIR BENJAMIN COLLINS BRODIE, Bart., Vice-President, in the Chair.

The reading of a paper entitled, "On the Ice, formed under peculiar circumstances, at the bottom of running Water." By the Rev. James Farquharson, of Alford, F.R.S., was resumed and concluded.

The ice, which is frequently observed to collect at the bottom of streams and rivers, differs in appearance from that which is formed at the surface; for, instead of assuming the shape of solid glass-like plates, it has more the appearance of aggregated masses of snow, and is composed of small crystals of ice adhering together irregularly, either by their sides or angles. Rivers are sometimes so choked up by accumulations of ground-ice of this description, that they are not only impeded in their course, but also raised considerably above their banks. While in this state, a slight change in the weather will frequently occasion the complete disengagement of this ice from the bottom; so that, in a very short space of time, the river returns into its natural channel;

and then, although it may be frozen at the surface, it continues to flow over a perfectly clear bottom. All these phenomena are considered by the author as perfectly explicable on the theory he advances, of different degrees of radiation of heat occurring from the bottom according to variations of circumstances. He conceives that when this radiation takes place from the solid opake materials of the bed of the stream, through the stratum of transparent water, congelation is induced on that portion of fluid, already cooled down to the freezing-point, which is in immediate contact with the radiating body. The circumstances which, by favouring radiation, contribute to this effect, are, principally, great clearness of the sky, and great transparency of the water; the bottom of the river being cooled below the freezing-point sooner than the water which is flowing over it; and the ice, formed at the bottom, remaining attached to it, as long as the heat which is transmitted from below continues to be lost by radiation. The formation of ground-ice is favoured by the intestine motions incident to a rapid current; because the different strata of fluid, which in still water would have arranged themselves, according to their specific gravities, in the order most conducive to the congelation of the surface, being continually mixed together, the whole body of water is cooled more uniformly.

The Society then adjourned over the Easter recess to meet again on the 30th instant.

April 30, 1835.

The REV. PHILIP JENNINGS, D.D., Vice-President, in the Chair.

A paper was read, entitled, "Continuation of the paper on the relations between the Nerves of Motion and of Sensation, and the Brain; and more particularly on the structure of the Medulla Oblongata and of the Spinal Marrow." By Sir Charles Bell, F.R.S.

The author enters into a minute anatomical investigation of the structure of the spinal cord, and of its relations with the encephalon, and with the origins of the nerves. He finds that the spinal cord is constituted, in its whole length, by six pairs of columns, namely, two posterior, two lateral, and two anterior; each column being composed of concentric layers, and invested with an external coating of cineritious substance, and all the columns being divided from each other by deep sulci, which penetrate nearly to the centre of the cord. On tracing the posterior columns in their ascent towards the encephalon, they are seen to diverge laterally at the *calamus scriptorius*, or bottom of the fourth ventricle, and to proceed into the substance of the cerebellum. Each of these posterior columns is here found to consist of two portions, the outermost being the largest; and they now constitute the *processus cerebelli ad medullam oblongatam*. This subdivision of the posterior columns may be traced throughout the whole length of the spinal cord. The lateral columns give origin to the posterior roots of the spinal nerves, and are therefore the parts subservient to sensation. In ascending towards the brain, each of these columns has a double termination; first, in the root of the fifth pair of cephalic nerves; and secondly, in the place where both columns unite into one round cord, and mutually decussate.

Between the lateral and the anterior columns there is interposed a layer of cineritious matter, constituting a continuous stratum from the *cauda equina* to the roots of the auditory nerves. There is also a septum, dividing the right and left tracts subservient to sensation in the region of the fourth ventricle, and apparently terminating at the point of decussation of these tracts; but, in reality, separating to allow of this decussation, and joining the central portion of the cord, which connects the posterior with the anterior columns, and extends from the *pons Varolii* to the *cauda equina.*

The anterior columns, constituting, at their upper part, the *corpora pyramidalia,* after their union and decussation, compose the motor columns of the spinal cord. They do not, in their course, unite or decussate with the lateral, or sensitive columns; decussation taking place only among the columns performing similar functions; that is, the motor columns with the motor, and the sensitive with the sensitive.

May 7, 1835.

Sir JOHN RENNIE, Knt., Vice-President, in the Chair.

The first paper read was entitled, "On the Elements of the Orbit of the Comet of Halley in 1759." By J. W. Lubbock, Esq., V.P. and Treasurer of the Royal Society.

In calculating the elements of Halley's comet, former astronomers have in general adopted the parabolic hypothesis, neglecting the reciprocal of the semi-axis major; and even in the more recent investigations of its orbit, no accurate value of this quantity has been employed. Mr. Lubbock, perceiving the serious effect which an error in the semi-axis major would occasion in the determination of the other elements, renewed these very laborious calculations, assuming as the value of this quantity that given by M. Pontécoulant, in his "Théorie analytique du Système du Monde;" taking also into account the alterations which the elements of the comet have undergone by the action of the planets, and likewise the effect of precession upon the longitude of the node, and of the perihelion. The author takes this opportunity of correcting the very erroneous statements that have been made respecting the results of his investigations, especially with regard to the time of the perihelion passage, which is, of course, very different from that of its actual appearance to spectators on the earth; although these two epochs are frequently confounded with one another.

The second was entitled, "Formulæ for computing the Longitude at Sea;" by William Dunlop, Esq. Communicated by the Secretaries.

These formulæ, in which the longitude and latitude of two points in a spherical surface, together with the arc of the great circle intercepted between them, are supposed to be given, furnish the means of determining the longitude of any other point in that circle, from its latitude.

The third paper was entitled, "Hygrometrical Observations made on board His Majesty's surveying vessel Ætna." Communicated by Captain Beaufort, R.N., F.R.S.

These observations extend from the 27th of March to the 6th of July, 1834, and were made daily at 8 o'clock A.M., at noon, and at 4 o'clock P.M. They comprise the height of the barometer, the dew-point, degrees of dryness on the thermometrical, and of moisture on the hygrometrical scales, the elasticity of the vapour, and the number of grains of vapour in a cubic foot; with occasional remarks. A second series is also given, exhibiting the progress of solar radiation.

The fourth was a "Meteorological Register, from the 1st of January to the 1st of November, 1834," by Mr. Edward Barnett. Communicated by Capt. Beaufort, R.N., F.R.S.

These observations, made during a voyage across the Atlantic, relate chiefly to the temperatures of the air, and of the surface of the sea.

The fifth was a "Meteorological Register, kept on board His Majesty's Ship Thunder, between the 1st of January and the 30th of June, 1834," by R. Owen, Commander. Communicated by Captain Beaufort, R.N., F.R.S.

These observations relate to the state of the weather, the direction and force of the wind, and the heights of the thermometer, and of the marine and oil barometers.

May 14, 1835.

JOHN WILLIAM LUBBOCK, Esq., Vice-President and Treasurer, in the Chair.

A paper was read, entitled, "An Account of the Water of the Well *Zem-zem*, with a qualitative analysis of the same by Professor Faraday"; in a letter from John Davidson, Esq., to the Secretaries, and communicated by them.

The author having, during his stay at Jedda, the port of Mecca, succeeded in procuring about three quarts of the water from the well of *Zem-zem*, to which the Mahomedans ascribe a sacred character and extraordinary virtues; and wishing to preserve this water for the purposes of analysis, had the can in which it was contained carefully sealed; but, unfortunately, on its arrival in the London Docks, the can, notwithstanding the directions written on it, was opened, and the gas with which it was highly charged, and by which it held in solution a very large quantity of iron and other matters, was allowed to escape. The precipitate thrown down, in consequence of the loss of this gas, was found, by Professor Faraday, to consist of carbonate of protoxide of iron in the enormous proportion of 100·8 grains to the imperial pint of water. The clear fluid was neutral, and contained much muriate, and a little sulphate, but no carbonate; together with a little lime, potash, and soda. There was also found an alkaline nitrate in considerable quantity; this Mr. Faraday conjectures to have been saltpetre, which had been added to the water by the priests.

The reading of a paper was commenced, entitled, "Observations on the Theory of Respiration." By William Stevens, M.D., D.C.L., Fellow of the Royal College of Physicians of Copenhagen, and of Surgeons of London. Communicated by W. T. Brande, Esq., V.P.R.S.

May 21, 1835.

WILLIAM THOMAS BRANDE, Esq., Vice-President, in the Chair.

The reading of the paper, entitled, "Observations on the Theory of Respiration." By William Stevens, M.D. D.C.L., Fellow of the Royal College of Physicians of Copenhagen, and of Surgeons of London. Communicated by W. T. Brande, Esq., V.P.R.S., was resumed and concluded.

From the fact that no carbonic acid gas is given out by venous blood when that fluid is subjected to the action of the air-pump, former experimentalists had inferred that this blood contains no carbonic acid. The author of the present paper contends that this is an erroneous inference; first, by showing that serum, which had been made to absorb a considerable quantity of this gas, does not yield it upon the removal of the atmospheric pressure; and next, by adducing several experiments in proof of the strong attraction exerted on carbonic acid both by hydrogen and by oxygen gases, which were found to absorb it readily through the medium of moistened membrane. By means of a peculiar apparatus, consisting of a double-necked bottle, to which a set of bent tubes were adapted, he ascertained that venous blood, agitated with pure hydrogen gas, and allowed to remain for an hour in contact with it, imparts to that gas a considerable quantity of carbonic acid. The same result had, indeed, been obtained, in a former experiment, by the simple application of heat to venous blood confined under hydrogen gas; but on account of the possible chemical agency of heat, the inference drawn from that experiment is less conclusive than from experiments in which the air-pump alone is employed. The author found that, in like manner, atmospheric air, by remaining, for a sufficient time, in contact with venous blood, on the application of the air-pump, acquires carbonic acid. The hypothesis that the carbon of the blood attracts the oxygen of the air into the fluid, and there combines with it, and that the carbonic acid thus formed is afterwards exhaled, appears to be inconsistent with the fact that all acids, and carbonic acid more especially, impart to the blood a black colour; whereas the immediate effect of exposing venous blood to atmospheric air, or to oxygen gas, is a change of colour from a dark to a bright scarlet, implying its conversion from the venous to the arterial character: hence the author infers that the acid is not formed during the experiment in question, but already exists in the venous blood, and is extracted from it by the atmospheric air. Similar experiments made with oxygen gas, in place of atmospheric air, were attended with the like results, but in a more striking degree; and tend therefore to corroborate the views entertained by the author of the theory of respiration. According to these views, it is neither in the lungs, nor generally in the course of the circulation, but only during its passage through the capillary system of vessels, that the blood undergoes the change from arterial to venous; a change consisting in the formation of carbonic acid, by the addition of particles of carbon derived from the solid textures of the body, and which had combined with the oxygen supplied by the arterial blood: and it is by this combination that heat is evolved, as well as a dark colour imparted to the blood. The author ascribes, however, the bright red colour of arterial blood, not to the action of oxygen, which is of itself completely inert as a colouring agent, but to that of the saline ingredients naturally contained in healthy blood. On arriving at the lungs, the first change induced on the blood is effected by the oxygen of the atmospheric air, and consists in the removal of the carbonic acid, which had been the source of the dark colour of the venous blood; and the second consists in the attraction by the blood of a portion of oxygen, which it absorbs from the air, and which takes the place of the carbonic acid. The peculiar texture of the lungs, and the elevation of temperature in warm-blooded animals, concur in promoting the rapid production of these changes.

May 28, 1835.

Sir BENJAMIN COLLINS BRODIE, Bart., Vice-President, in the Chair.

A paper was in part read, entitled, "On the Influence of the Tricuspid Valve of the Heart on the Circulation of the Blood." By Thomas Wilkinson King, Esq., M.R.C.S. Communicated by Thomas Bell, Esq., F.R.S.